ANALYSIS OF PROFITABILITY THROUGH WITH THE GENERATION OF L-SCENARIOS FROM A HYBRID METHOD BETWEEN ARTIFICIAL NEURAL NETWORK AND MONTE CARLO SIMULATION

Bermeo, J.[a], Castillo, H.[b], Serrano, S.[c], Arce, D.[d] , Bermeo, H.[e]

[a],[b],[c] ,[d]Universidad Politécnica Salesiana, Cuenca, Ecuador
[e]Universidad de Cuenca, Cuenca, Ecuador

[a]jbermeo@ups.edu.ec, [b]hcastillo@ups.edu.ec, [c]sserrano@ups.edu.ec
[d]darce@ups.edu.ec , [e]henry.bermeo@ucuenca.edu.ec

ABSTRACT
Business Intelligence analyze existing data, to create knowledge about environment, in this paper, the accounting and operating information is analyzed to generate L-scenarios from hybrid method between ANN and Monte Carlo Simulation (MCS), then analyze the profitability in a Collection center of Raw milk. Every scenario is generated into analysis period, and has information about purchases, sales, cost of goods, sales price, operative cost and opportunity cost, then the cash flow, Net Present Value NPV and Modified Internal Rate of Return MIRR is calculated in order to evaluate the profitability of each scenario. The statistics (with a 95% of confidence) shows that MIRR has a confidence interval between 18,8% and applying an expected rate of return of 20% results in the average NPV is positive, so it implies the project is profitable. Furthermore, the opportunity cost analysis suggests proposes to increase the plant size.

Keywords: Artificial Neural Network ANN, Monte Carlo simulation MCS, Business Intelligence BI, decision making, profitability, Net Present Value NPV, Internal Rate of Return IRR, Modified Internal Rate of Return MIRR.

1. INTRODUCTION

The reality is ruled by many variables, then variable groups would create some possibilities and constraints, which make scenarios. For decision making, business leaders must analyze each scenario with a validation criteria defined from aims of company, Figure 1 shows this scheme.
In this way, the aim of an investor, in the beginning of company, is to have a measurement about the profitability, the net present value (NPV) (Brealy, Myers, & Allen, 2013) or Internal Rate of Return (IRR) (Ross, Jordan, & Westerfield, 2014) so as to could estimate the anticipated profitability of project or investment, however, the real problem is the generation of reliable information to evaluate the NPV. New approaches of Business Intelligence (BI) are implemented with the use of Artificial Intelligence (AI) (Alexander & Jothivenkateswaran, 2016), (Kwon, Wu, & Zhang, 2016) in this paper, L-scenarios were created through a forecasting of purchases, sales, prices and cost are generated by AI and Monte Carlo Simulation, then all this information was used to estimate NPV and MIRR of the project in every scenario. Finally, profitability is evaluated by statistical analysis.

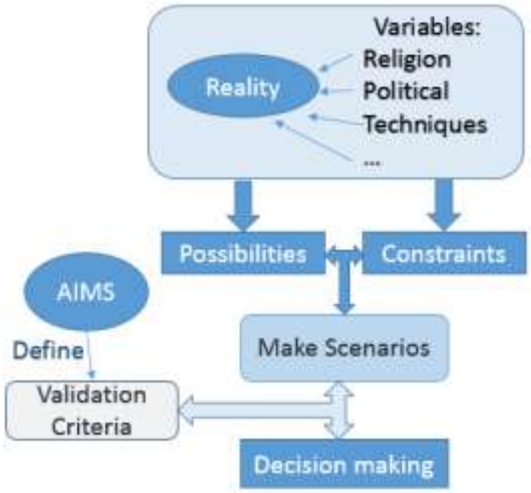

Figure 1: Scheme for decision making

For the forecasting of purchases by day, a hybrid method between Artificial Neural Network (ANN) and Monte Carlo Simulation (MCS), (Bermeo, y otros, 2017) was used. In addition, the generation of costs, sales and price were generated by Monte Carlo Simulation (Lebovka, Vygornitskii, Gigiberiya, & Tarasevich, 2016) from statistics of the historical accounting information of company.
Information from forecasting is applied to estimate yearly Gross profit for each scenario, then the Net profit was calculated considering the taxes and total operating expenses. Next, the system calculates the NPV and IRR, and make and statistics analysis to evaluate the scenarios. Figure 2 sketches the process for this paper. First, it begins with a little explanation of hybrid model between ANN and MCS. Second, L-scenarios were created by

hybrid model and MCS, where the hybrid model generates amount of purchases daily, and MCS generates values for costs, sales and price. Third, system calculates the yearly Net profit, NPV and MIRR, for every scenario. Finally, a statistics analysis supports the estimation about the profitability in all scenarios.

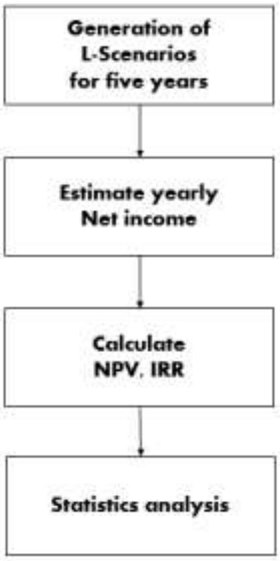

Figure 2: Flowchart for

2. HYBRID MODEL BETWEEN ANN AND MCS

The ANN is training with the historical information of purchases to make a forecasting, after the training, these predictions only need a limited group from historical information of purchases. The Monte Carlo Simulation applies accumulated probability density, estimated from historical records, to generate L-times a limited group of historical information. Next, every limited group is the input for trained ANN to generate a scenario, which is the forecasting of purchases, so at the end, they are L-scenarios, where each scenario is the amount daily purchase in desired period for the simulation. The figure 3 describes graphically the scheme of hybrid model.

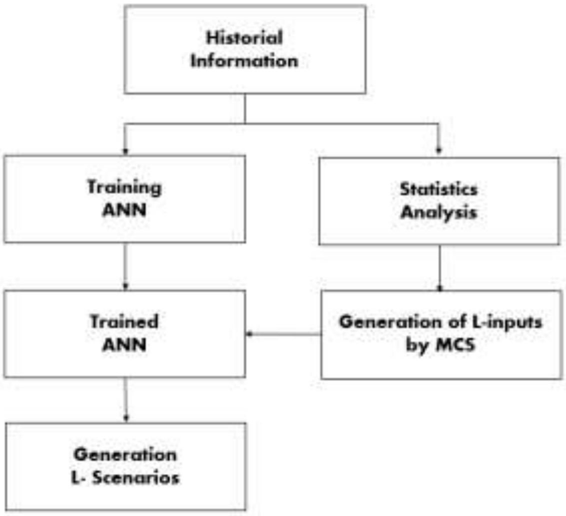

Figure 3: Scheme of hybrid model

2.1. Training ANN

ANN is training with the Historical information of company. In this case, the Inputs are thirty-three: year, month of prediction, amount of milk purchases in i-th day before the prediction day (P_1…P_30). The output is the amount of milk purchases in the prediction day (P_0).

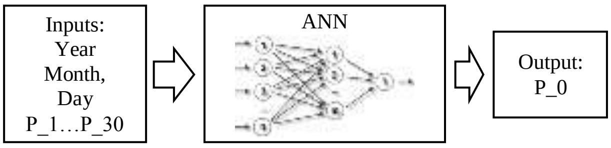

Figure 4: ANN implemented

2.2. Analysis of probability density function of daily purchases

First step is the analysis of probability density function (pdf) from milk purchases in this case. The figure 5 shows a comparative between relative frequency from real dates and a normal distribution applying the statistics information from table 1.

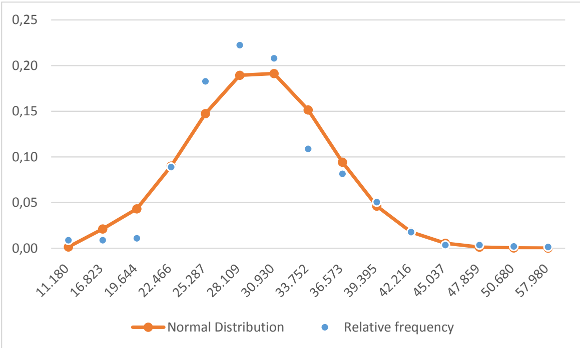

Figure 5: Analysis of Relative frequency of milk purchases

Table 1: Statistics of milk purchases

Factors			
Average	Standard Deviation	Minimum	Maximum
28.214,4	5.678,1	731	57.976,8

2.2.1. Chi-square test

The chart of relative frequency of milk purchases looks like normal distribution with average and standard deviation from table 1, however, the graphic is not enough to support that pdf of milk is a normal distribution, so it is necessary a Chi-square goodness of fit test (Balakrishnan, Voinov, & Nikulin, 2013). For this case, hypothesis Ho is defined by “frequency of milk purchases conforms a normal distribution”.

After the apply the test, table 2 shows the results from Chi-square test with 5% of significance level, in conclusion, test raise that Ho must be accepted, it means, the frequency of milk purchases conforms a normal distribution.

Table 2: Chi-square goodness of fit test

Factors: daily milk purchases			
Degrees of Freedom	χ Reference	χ Calculated	Ho
1460	1.372,27	246,34	Accepted

2.2.2. Estimate L

The normal accumulative probability density function can be used by MCS because Ho is accepted, so MCS is used to generate L-inputs for ANN. Next, outputs from neural network are used iteratively to complete the milk purchases in the desired period. In this case study, inequality (1) estimates the value of L, where a confidence interval of 95% (z=1,96), standard deviation from table 2, and an error close to one percent of average (error=282.14) are used, so L minimum is 1555,87. In this experiment L=1600 was used.

$$L \geq \left(\frac{z_{\alpha/2} \cdot S}{error}\right)^2 \quad (1)$$

2.3. Generation of L-inputs by MCS

Each ANN input has thirty-three records, so Monte Carlo Simulation with the normal accumulative pdf generates thirty-three random numbers for each input, the figure 6 shows L-inputs generated by MCS.

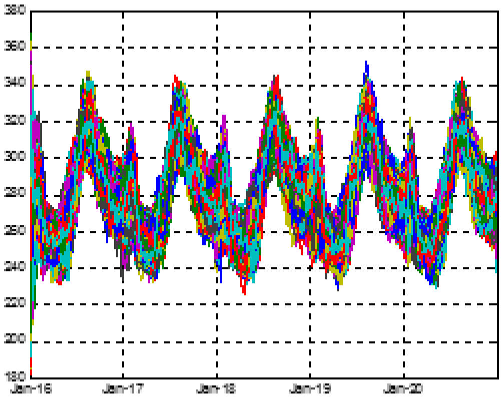

Figure 6: L-inputs generated by MCS

2.4. Generation of L-scenarios

Each input is entered to ANN to get prediction in one day, then a position is shifted in original input, and between the new prediction and shifted input a new input is created. This process is repeated until to get whole prediction in the desired period, all this information conforms a scenario, so L-inputs will generate L-scenarios. Figures 7 sketches L-scenarios generated for five years of milk purchases.

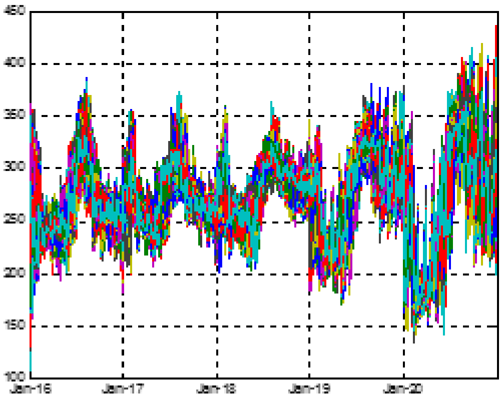

Figure 7: Hybrid method generates L-scenarios of Milk purchases

3. ESTIMATION OF NPV, IRR AND MIRR FROM L-SCENARIOS

3.1. Input information

Hybrid method generates daily milk purchases, and the similar way, MCS generates demand of monthly liters (D), cost per liter of raw milk (C), and sales price per liter (P) from historical accounting information. In addition, Opportunity cost per liter (O) and Retention cost per liter (R) even though are fixed for first month, the inflation rate is applied for next months to build a matrix of inflation. The value used for inflation rate was 8.83% (INEC, Instituto Nacional de estadística y censos, 2016), which is the biggest in the last decade. The table 3 shows the statistics values applied for simulation by MCS. Furthermore, the rate of population growth (1.31% (Central Intelligence Agency, CIA, 2017)) was applied to amount of monthly liters sold.

Table 3: Statistics of accounting information

Description	Average	Standard Deviation
Cost of Milk per liter	$ 0,4485	$ 0.0265
Monthly liters sold	879 883,4	257 397.9
Price of milk sold/lt.	$ 0,4831	$ 0.0203

3.2. Gross Profit (GP)

The data of milk purchases are daily, so they are consolidated to get monthly purchases, in the case of collection of raw milk, the 97% from all purchases will be the supply (Q) the 3% is spoiled. Then, for each month, the Demand (Di) and supply (Qi) of i-th month are compared. If Di is shorter than Qi, implies that the sales only could be a Di, and there are stocktaking for the next month equals to Qi-Di, in the other case when Di is larger than Qi, then sales are Qi and there are a deficit equals to Di-Qi. The retention cost (R_{CT}) is equal to stocktaking by retention cost per liter (RC), and Opportunity cost (O_T) is equal to deficit by Opportunity cost per liter. The cost of goods sold (CM) is equal to supply in i-th month (Qi) by cost per liter (C). Finally, the Gross profit (GP) is equal to Gross Sales (GS) minus cost of goods sold (CM), retention cost (R_{CT}) and opportunity cost (O_T). Figure 8 sketches the process to calculate the Gross profit.

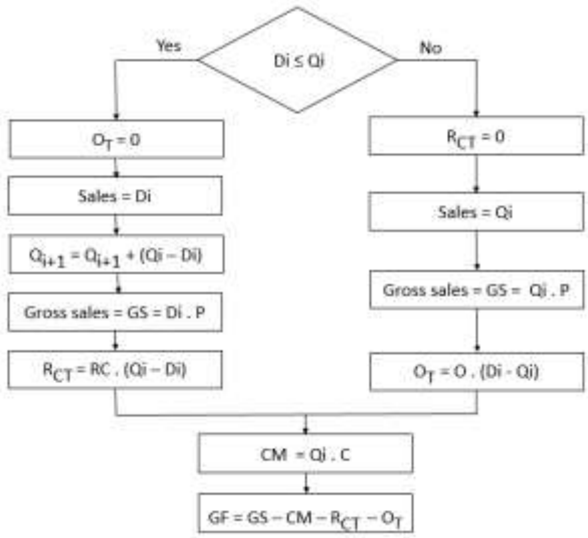

Figure 8: Calculation of Gross Profit

3.3. Retention Cost and Opportunity Cost

The retention cost define the retention capability, if firms make a good job then the Customer lifetime value (CLV) is increased (Zhang, y otros, 2015), in the case of Collection Center, where the rate of churn is almost zero, so the retention cost is only composed by the cost of storage to have enough supply for the customers. From historical values, the storage cost is $ 0.015 per liter, then matrix of inflation rate is applied to get the retention cost per liter (RC). In figure 7 shows that RC must only apply to stocktaking.

There are an infinite ways to evaluate the opportunity cost, one of them is the estimation in terms how the system translates changes in resources into changes in benefits, (Sculpher, Claxton, & Pearson, 2017), and so opportunity cost can be estimated from inefficiency, for the case of study, it is the deficit of supply to reach the demand. Obviously, in this model, opportunity cost should not affect cash flow, so the opportunity cost is estimated only for analyzing the increase of plant size. The opportunity cost is 1.5 cents by liter of deficit. So this rate with matrix of inflation is applied to estimate the opportunity cost.

3.4. Net Income

The equation (2) defines the operating profit by Gross profit minus operating expenses. Net Income is defined by Operating profit minus taxes, in this case, the real taxes in Equator are 33,7%, first 22% for income tax, which is applied to operating profit (SRI, Servicio de Rentas Internas, 2017), and second, 15% to pay utilities to workers, which is applied after the income tax, so equation (3) shows how estimate the Net Income. Figure 9 shows monthly Net income from scenarios.

$$\text{Operating profit} = GP - OE \quad (2)$$

$$\text{Net Income} = \text{Operating profit} \cdot (1\text{-}33{,}7\%) \quad (3)$$

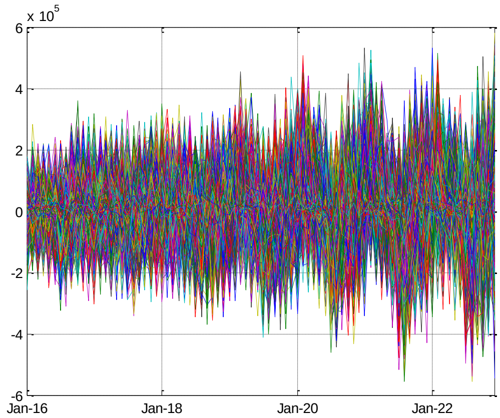

Figure 9: Net Income of L-scenarios

Even though the figure 9 shows a fuzzy information about the Net Income, a statistics analysis will help to understand and interpret this information.

3.5. Investment and depreciation

The table 4 shows a detail the investment for the company of Collection Center. Furthermore, the years for depreciation are showed.

Table 4: Detail of Investment and Years for depreciation

Description	Investment	Useful life in Years
Civil Works	80.000,00	20
Ice Bank construction	28.000,00	20
Generators	12.000,00	10
Stainless Steel Tanks	30.500,00	20
Design	4.500,00	3
Working capital	25.000,00	3
Unexpected	18.000,00	3
TOTAL Investment	198.000,00	

Straight Line Depreciation is the default method used, where the annual depreciation is calculated by equation four (Meigs, Williams, Bettner, & Haka, 2000), where the annual depreciation is equal to initial asset cost divided by the useful life of asset.

$$\text{Annual Depreciation} = \frac{\text{Asset cost}}{\text{Useful life}} \quad (4)$$

3.6. Cash Flow

The Cash Flow is a financial report that presents a detail of the cash and income flows in analysis period. In this case, the Income is only made up from Gross Sales. The sales cost is the sum of cost of goods sold (CM), retention cost (R_{CT}) and opportunity cost (O_T). The operative expenses include basic services, salaries, social benefits, transportation y depreciation.

Table 5: Equations to estimate Net Flow

Description	Equation
Income (Gross Sales-GS)	P*Sales
Sales Cost (SC)	CM+ R_{CT}+ O_T
Gross Profit (GP)	GS-SC
Operative Expenses (OE)	OE
Operating Profit (OP)	GP-OE
Financial expenses (FE)	
Profit before taxes (PBT)	OP-FE
Income Tax (IT)	0.22*PBT
Net Profit (NP)	PBT-IR
Depreciation (D)	D
Payment of Capital (PC)	PC
Net Flow	NP+D-PC

3.7. Net Present Value NPV

The Net Present Value NPV is a measurement of profitability of investment project, the equation (5) shows how to calculate it from yearly Net Flow (NF), initial investment and rate of minimum return "i".

$$NPV = \sum_{t=0}^{n} \frac{NF_i}{(1+i)^t} \tag{5}$$

When NPV is larger than zero, it means that investment would add value to investors, then the project may be accepted, if NPV is negative means investment would subtract value from the investors. Once the NPV=0 means that investment would neither gain nor lose value to investors, so NPV is indifferent to accept or reject the project.

The rate of minimum return must be related at least with the following factors: the risk-free rate of return, the "market price of (dollar) risk", and the variance in the project's own present value return (Lintner, 1965), but new approaches raise the Expected return, which depend on Risk-free rate, equity risk premium, small cap risk premium and book to market premium (Damodaran, 2015). The process to estimate the Expected return is quite complex and it is out the aim of this paper, so for the collection center, where risk country rate is about 667 points (Banco Central del Ecuador, 2017), and this can apply to estimate a required throughput rate (Gnecco, 2011), in addition, the maximum inflation rate in last decade was 8.83%, passive interest rate 4,82%. If 5% is applied like as risk-free rate, it means, the Expect return should be over 19%. In this work, the rate of minimum return applied is 20%to estimate the NPV.

Figure 10 shows the NPV from 1600 scenarios, even though, there is a big variation, the most scenarios have a positive NPV.

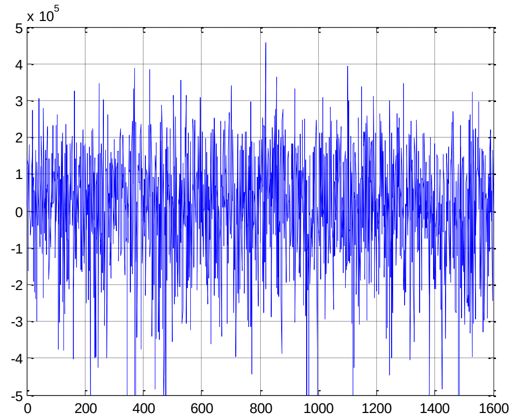

Figure 10: Net Present Value of L-scenarios

3.8. Internal Rate of Return IRR

The internal rate of return (IRR) provide the profitability of project, when their funds remain in the project during whole their life. When this rate is applied to estimate the NPV then the result of NPV is zero, in the context of savings and loans the IRR is also called the effective interest rate. There are a lot of methods to calculate the IRR, the equation (6) are used to estimate de IRR value. The IRR must be over to the sum between rate of inflation and risk premium.

$$NPV = \sum_{t=0}^{n} \frac{NI_i}{(1+IRR)^t} = 0 \tag{6}$$

For L-scenarios, the calculated IRR shows a big variation, the figure 11 shows the IRR by scenario, where there is a positive tendency.

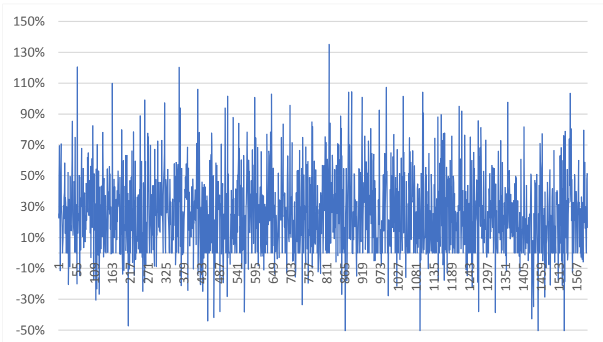

Figure 11: IRR of L-scenarios

3.9. Modified Internal Rate of Return MIRR

The modified internal rate of return (MIRR) is more accurate than IRR, because MIRR assumes that positive cash flows are reinvested, and negatives cash flows have a financial cost. On the other hand, IRR assumes that all cash flows are reinvested at the same IRR. Equation (7) shows how to evaluate MIRR, where PCFi is Positive Cash Flow in i-th year, NCFi is the negative cash flow in i-th year (when i=0 is the initial investment), r is cost of capital of company and fc is the financial cost rate. For this case, the financial cost rate is 11.83% (Banco Central del Ecuador, 2017), which is equal to average interest for loans to SMEs (small and medium-sized enterprises) from banks. The r applied is the 8.83% taking into consideration the maximum inflation, because in the worst case, the reinvestment in the company should be at least higher than inflation.

$$MIRR = \sqrt[n]{\frac{\sum_{i=1}^{n} PCF_i \cdot (1+r)^{n-i}}{\sum_{i=0}^{n} NCF_i/(1+fc)^{i}}} - 1 \qquad (7)$$

For L-scenarios, the figure 12 displays a comparative between IRR and MIRR, where the calculated MIRR has a slower variation than IRR.

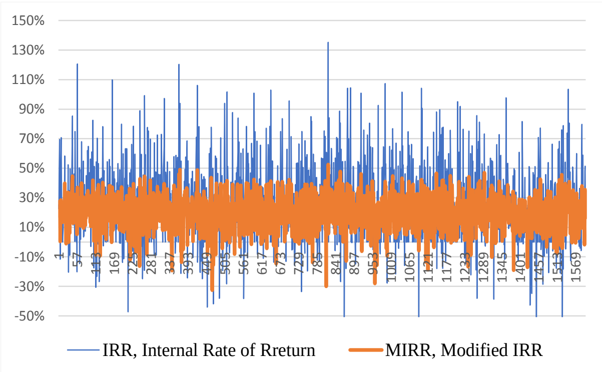

Figure 12: MIRR and IRR of L-scenarios

4. STATISTIC ANALYSIS FROM SIMULATION

Information in figure 9 is confused, but when the average is calculated, like as in the figure 13, these is friendlier to analyze, for example, the average of amplitude will increase over time, and Net Income maintains a steadily increasing form but within five years of prediction, it is still stable, so the information could be used to calculate the NPV, IRR and MIRR with enough accurate.

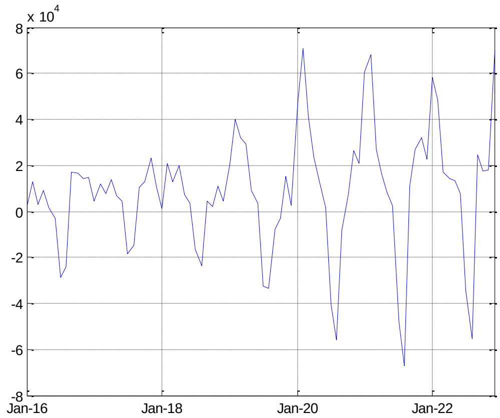

Figure 13: Average monthly Net Income of L-scenarios

The figure 14 shows the histogram of NPV, where this had a bell form, and the Chi-square goodness of fit test (Table 4), point out this is similar to Gauss distribution, and additionally maximum is near to the average, which is shown in table 5.

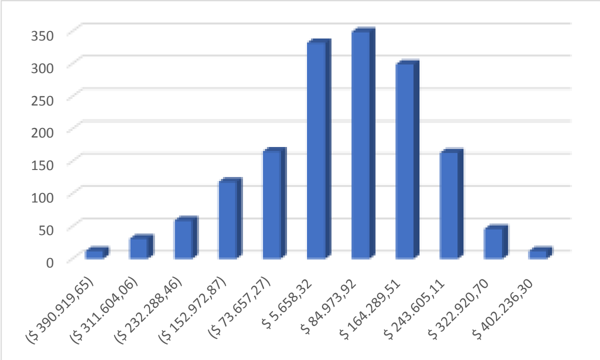

Figure 14: NPV histogram

Histogram of IRR, showed in the figure 15, and Chi-square goodness of fit test (Table 4) indicates that there is a Gauss distribution, furthermore the average is near to the value showed in Table 5.

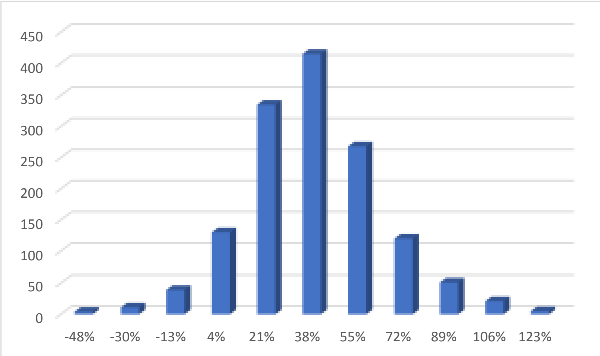

Figure 15: IRR histogram

Figure 16 shows the histograms of IRR and MIRR, where MIRR has a smaller standard deviation than IRR, it means that MIRR values are less spread than IRR values.

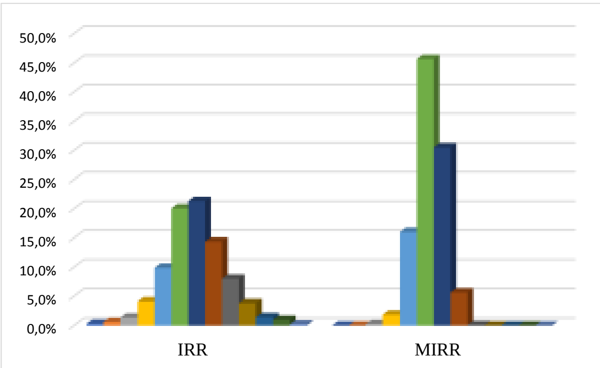

Figure 16: IRR and MIRR

The results of Chi-square goodness of fit test for NPV, IRR and MIRR point out that all distributions are Gaussians, it means, the normal distribution can be applied for the calculus of confidence interval.

Table 6: Chi-square goodness of fit test

Net Present Value NPV			
Degrees of Freedom	χ Reference	χ Calculated	Ho
1599	1.717,28	611,09	Accepted
Internal Rate of Return IRR			

ISBN 978-88-97999-85-0; Affenzeller, Bruzzone, Jiménez, Longo and Piera Eds.

Degrees of Freedom	χ Reference	χ Calculated	Ho
1384	1.493,15	79,19	accepted
Modified Internal Rate of Return MIRR			
Degrees of Freedom	χ Reference	χ Calculated	Ho
1599	1.717,28	53,22	accepted

Average and standard deviation from L-scenarios are calculated and showed in table 7, the averages of NPV, IRR and MIRR indicate that the project will have a good profitability.

Table 7: Statistics of NPV, IRR and MIRR

N = 1600 scenarios		
Factor	Average	Standard Deviation
Net Present Value NPV	\$ 5 658	\$ 158 631
Int. Rate of Return IRR	29 %	26%
Modified IRR, MIRR	19 %	11 %

Even though the indicators point out that there is a great profitability, it is necessary to use the confidence interval (equation (7)) to obtain a better analysis (Walpole, Myers, Myers, & Ye, 2012). Equations (7) and (8) indicate the confidence intervals of 95% ($Z_{\frac{\alpha}{2}}$=1.96) for the NPV and IRR respectively.

$$P\left(\bar{X} - Z_{\frac{\alpha}{2}}\frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{X} + Z_{\frac{\alpha}{2}}\frac{\sigma}{\sqrt{n}}\right) = 1 - \alpha \qquad (7)$$

$$P((\$2\ 114) \leq \mu_{VPN} \leq \$\ 13\ 431) = 0{,}95 \qquad (8)$$

$$P(27{,}9\% \leq \mu_{IRR} \leq 30{,}5\%) = 0{,}95 \qquad (9)$$

$$P(18{,}8\% \leq \mu_{MIRR} \leq 20{,}0\%) = 0{,}95 \qquad (10)$$

Equation (8) indicates that 95% of all scenarios will have a VPN between \$2 114 and \$ 13 431, so the investors will earn money with the project. In the same way, equation (9) point out that IRR are between 27,9% and 30,5%, considering an inflation rate about 8,83%, it implies that Collection Center will have a premium between 19,0% and 21,7% into the 95% of L-scenarios. Even though, the opportunity cost doesn't affect the cash flow, the analysis cost could be useful to determinate the optimal plant size, figure 17 sketches the opportunity cost for every scenario, and table 8 shows the statistics, where the average is over two hundred thousand, it implies that company is losing this value into income, by their constraint in size plant.

Table 8: Statistics of Opportunity Cost

N = 1600 scenarios		
Factor	Average	Standard Deviation
Opportunity Cost	\$ 212 554	\$ 48 089

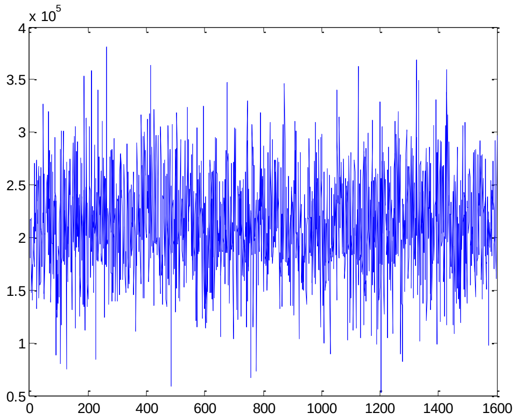

Figure 17: Opportunity Cost from L-scenarios

Table 8 point out the opportunity cost have a high average enough to make a change, it means, plant size should be increased to avoid deficit every month.

5. CONCLUSIONS

The hybrid method and Monte Carlo Simulation could generate L-scenarios to make a measurement of profitability with a big confidence, as can be seen in equation (8) and (9).

In this work, the generation of L-scenarios was applied to get a financial factor, however the hybrid method between ANN and MCS could be used in other applications too, for example to generate L-scenarios of Load on electric transmission lines in order to estimate life time of transformers.

For the application of hybrid method and MCS, is always necessary to have historical information for two reasons: (i) training of ANN, (ii) estimate statistics information to generate Inputs by Monte Carlo Simulation, how it is showed in the diagram of figure 2.

The large of historical information should be as large as at least the half of prediction, in order to be in a stable zone how is shown in figure 11, because sometimes when the prediction is larger than twice of the training period, then the system become unstable.

The Chi-square goodness of fit test is a great tool to define what kind of probability density function could be used, in this work, the test shows that variables (inputs and output) follow a Gauss distribution function.

The confidence interval of NPV, in equation (8), shows that the project has a great likelihood to get successful, so the project must be accepted, however the big standard deviation shows that system is very sensitive to whatever change, so the management of the collection center is an important issue to be considered.

Equation (10), shows that the project has a positive premium for MIRR, added to fact that it has a high probability of occurrence, around of 95%. Moreover, with positive NPV, it implies the project should be executed.

With the generation of L-scenarios, it is possible to calculate other financial factors like Gross margin (see figure 16), operating margin, profit margin, ROE, etc. to make a statistics and financial analysis, so the model used could be applied in future works of budget simulations o supply chain management.

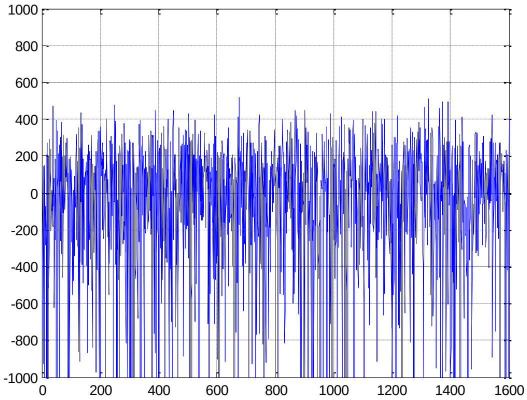

Figure 16: Gross Margin for L-scenarios

The increase of plant size must be realized when the benefit exceeds the cost, the table 6 shows that the average is over two thousands in five years, so if the collection center increase the plant size then they will have enough income to afford that, in addition an extra benefit.

6. REFERENCES

Alexander, A., & Jothivenkateswaran, C. (2016). Analysing genetic algorithm techniques on data mining for constructing Effectual Business Intelligent System (EBIS). *International Journal of Control Theory and Applications, 9*(10), 4479-4484.

Balakrishnan, N., Voinov, V., & Nikulin, M. (2013). *Chi-Squared Goodness of Fit Tests with Applications* (1st ed.). Ontario: Academic Press.

Banco Central del Ecuador. (2017, 3 1). Retrieved from https://contenido.bce.fin.ec/resumen_ticker.php?ticker_value=riesgo_pais

Banco Central del Ecuador. (2017, 03 1). *BCE, Banco Central del Ecuador*. Retrieved from https://contenido.bce.fin.ec/docs.php?path=/documentos/Estadisticas/SectorMonFin/TasasInteres/Indice.htm

Bermeo, J., Castillo, H., Armijos, X., Jara, J., Sanchez, F., & Bermeo, H. (2017). Artificial Neural Network and Monte Carlo Simulation in a Hybrid Method for Time Series Forecasting with Generation of L-Scenarios. *13th IEEE International Conference on Ubiquitous Intelligence and Computing, 13th IEEE International Conference on Advanced and Trusted Computing, 16th IEEE International Conference on Scalable Computing and Communications, IEEE International Conference o* (pp. 665-670). Toulouse; France: Institute of Electrical and Electronics Engineers Inc. doi:10.1109/UIC-ATC-ScalCom-CBDCom-IoP-SmartWorld.2016.0110

Brealy, Myers, & Allen. (2013). *PRINCIPIOS DE FINANZAS CORPORATIVAS* (11 ed.). Mexico: Universidad Autónoma de México.

Central Intelligence Agency, CIA. (2017, april 2). *Central Intelligence Agency, the work of nation*. Retrieved from The center of intelligence: https://www.cia.gov/library/publications/the-world-factbook/geos/ec.html

Damodaran, A. (2015). *Applied Corporate Finance*. New Jersey: John Wiley & Sons.

Gnecco, M. (2011). *Riesgo País y Tasa de Rendimiento Exigida*. Mar del Plata: Editorial Académica Española.

INEC, Instituto Nacional de estadística y censos. (2016, 12 1). *Ecuador en cifras*. Retrieved from http://www.ecuadorencifras.gob.ec/inflacion-diciembre-2016/

Kwon, O., Wu, Z., & Zhang, L. (2016). Study of the forecasting performance of China stocks' prices using business intelligence (BI): Comparison between normalized and denormalized data. *Academy of Accounting and Financial Studies Journal, 20*(1), 53-69.

Lebovka, N., Vygornitskii, N., Gigiberiya, V., & Tarasevich, Y. (2016, December 30). Monte Carlo simulation of evaporation-driven self-assembly in suspensions of colloidal rods. *Statistical, Nonlinear, and Soft Matter Physics, 94*(6), Article number 062803. doi:10.1103/PhysRevE.94.062803

Lintner, J. (1965). The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets . *The Review of Economics and Statistics*, 13-37.

Meigs, R., Williams, J., Bettner, M., & Haka, S. (2000). *Contabilidad: La Base para Decisiones Gerenciales*. Mishawaka, USA: Mcgraw-Hill.

Ross, S., Jordan, B., & Westerfield, R. (2014). *Fundamentos de Finanzas Corporativas* (9 ed.). Bogota: MC GRAW HILL.

Sculpher, M., Claxton, K., & Pearson, S. (2017, February). Developing a Value Framework: The Need to Reflect the Opportunity Costs of Funding Decisions. (Elsevier, Ed.) *Value in Health*, 234-239.

SRI, Servicio de Rentas Internas. (2017, 1 1). Retrieved from SRI, Servicio de Rentas Internas: http://www.sri.gob.ec/de/167

Walpole, R., Myers, R., Myers, S., & Ye, K. (2012). *Probabilidad y estadística para ingeniería y ciencias*. Mexico: Pearson Educación.

Zhang, Z., Wang, R., Zheng, W., Lan, S., Liang, D., & Jin, H. (2015). Profit Maximization Analysis Based on Data Mining and the Exponential Retention Model Assumption with Respect to Customer Churn Problems. *Data Mining Workshop (ICDMW), 2015 IEEE International Conference on* (p. 5). Atlantic City, NJ, USA: IEEE.

ISBN 978-88-97999-85-0; Affenzeller, Bruzzone, Jiménez, Longo and Piera Eds.